Agst. 3, 178

CONN.
S
43
.E82
no.178

CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN, CONN.

BULLETIN 178, SEPTEMBER, 1913.

THE CHESTNUT BARK DISEASE

CONTENTS.

	Page
Cause of Disease	6
Description of Disease	6
Remedies Tried	7
Dissemination of Spores	8
Progress of Disease	9
Distribution in Connecticut	9
Distribution in the United States	11
Relation to Host Conditions	12
Present Situation and Future Prospects in Connecticut	12
Work Done in Connecticut	13
Work Done by Other States	14
Historical	15
Range and Conditions of Growth	15
Character of Wood and Utilization	16
Mill Practice	17
Recommendations	18

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to others as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

OFFICERS AND STAFF.

BOARD OF CONTROL.

His Excellency, SIMEON E. BALDWIN, *ex officio, President.*
PROF. H. W. CONN, *Vice President*.....Middletown
GEORGE A. HOPSON, *Secretary*.....Wallingford
E. H. JENKINS, *Director and Treasurer*.....New Haven
JOSEPH W. ALSOP.....Avon
WILSON H. LEE.....Orange
FRANK H. STADTMUELLER.....Elmwood
JAMES H. WEBB.....Hamden

STATION STAFF.

ADMINISTRATION.
E. H. JENKINS, PH.D., *Director and Treasurer.*
MISS V. E. COLE, *Librarian and Stenographer.*
MISS L. M. BRAUTLECHT, *Bookkeeper and Stenographer.*
WILLIAM VEITCH, *In Charge of Buildings and Grounds.*

CHEMISTRY.

ANALYTICAL LABORATORY.
JOHN PHILLIPS STREET, M.S., *Chemist in Charge.*
E. MONROE BAILEY, PH.D., C. B. MORISON, B.S.,
C. E. SHEPARD, G. L. DAVIS, *Assistants.*
HUGO LANGE, *Laboratory Helper.*
V. L. CHURCHILL, *Sampling Agent.*
MISS E. B. WHITTLESEY, *Stenographer.*

PROTEID RESEARCH.
T. B. OSBORNE, PH.D., *Chemist in Charge.*
MISS E. L. FERRY, M.S., *Assistant.*

BOTANY.
G. P. CLINTON, S.D., *Botanist.*
E. M. STODDARD, B.S., *Assistant.*
MISS M. H. JAGGER, *Seed Analyst.*
MISS E. B. WHITTLESEY, *Herbarium Assistant.*

ENTOMOLOGY.
W. E. BRITTON, PH.D., *Entomologist; State Entomologist.*
B. H. WALDEN, B.AGR., *First Assistant*, Q. S. LOWRY, B.S., I. W. DAVIS, B S., *Assistants.*
MISS F. M. VALENTINE, *Stenographer.*

FORESTRY.
WALTER O. FILLEY, *Forester; also State Forester and State Forest Fire Warden.*
A. E. MOSS, M.F., *Assistant Station Forester.*
MISS E. L. AVERY, *Stenographer.*

PLANT BREEDING.
H. K. HAYES, M.S., *Plant Breeder.*
C. D. HUBBELL, *Assistant.*

GENERAL DESTRUCTION OF CHESTNUT BY BLIGHT.

THE CHESTNUT BARK DISEASE.

Endothia gyrosa var. *parasitica* (Murr.) Clint.

By E. M. Stoddard, *Asst. Botanist,*
and A. E. Moss, *Asst. Forester.*

To the owner of chestnut woodland the vital questions are; What is killing the chestnuts? and, What are the prospects of maintaining the chestnut as a forest tree?

FIG. I. TREES KILLED BY CHESTNUT BLIGHT.

It is the purpose of this bulletin to answer the first question and to give such other information that the reader may have a clearer understanding of the problem and judge for himself what

is the best course to pursue under the particular conditions in which his woodlot is situated.

CAUSE OF DISEASE.

First of all, let it be clearly understood that the chestnut blight is caused by a *fungus* and *not* by an *insect,* as is often erroneously supposed. The fact that insects of various kinds are found in the dead bark of an affected tree has often led to the conclusion that the trouble is of insect origin, but such is not the case and insects have no part in causing chestnut blight.

DESCRIPTION.

The chestnut disease is caused by the fungus technically known as *Endothia gyrosa* var. *parasitica.* This fungous parasite pene-

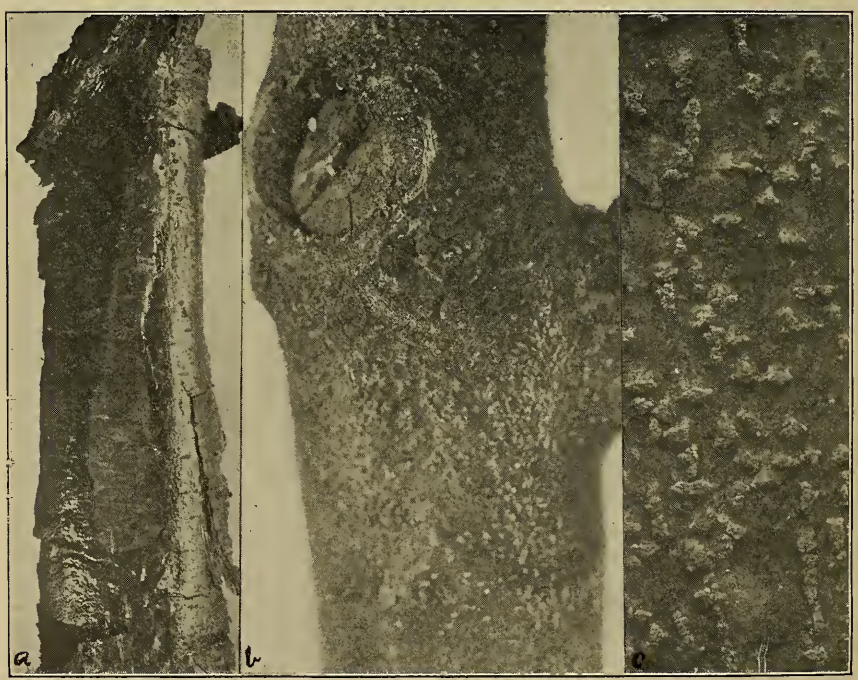

FIG. 11. BLIGHT STARTED THROUGH INSECT INJURY (A), AND PRUNED BRANCH (B); C. MATURE FRUITING PUSTULES ON SMOOTH BARK.

trates the bark to the wood of the chestnut tree, killing the invaded tissues, but does not enter into the wood to any appreciable extent nor does it affect directly any part of the tree other than that with which it comes in contact. The tree or branch is killed only when the disease goes completely around it, thus girdling it and stopping the flow of sap to the parts above the infected area.

The mycelium or vegetative part of the fungous plant grows, as has been stated before, in and beneath the bark and the spores are borne in characteristic red-brown or orange-colored pustules. These are seen dotting the surface of the cankers on smooth bark and thickly clustered in the crevices of rough bark. The spores are the bodies by which the organism perpetuates itself and are borne on the fruiting pustules in countless numbers. There are two forms of these spores, one of which is borne in the summer and the other in late fall and winter, both being capable of infecting chestnut trees under the proper condition. So small are the summer spores that 8,000 of them placed end to end equal an inch in length. The chestnut blight fungus does not so far as known injure any other kind of tree nor does it usually attack a tree unless the bark has been injured or the tree is in a weakened condition. It has, however, been found to a very limited extent on a few oaks, but never doing any appreciable injury.

REMEDIES TRIED.

At present there are no sure remedies known for this disease, because the fungus grows wholly within the tree, only its fruiting pustules appearing on the surface, thus making it very difficult to control the disease by spraying even if it were practicable to do spraying in a chestnut forest. Other methods of control have also proved unsuccessful.

Spraying. It has been claimed that spraying with Bordeaux mixture will prevent trees from becoming infected, which it doubtless would if the tree had no wounds in the bark and could be covered completely with the mixture at all seasons of the year. But this is nearly impossible and surely impracti-

cable except perhaps on single trees used for ornamental purposes.

Medication. Injecting various substances into the tree has been tried but with no success, as any substance sufficiently poisonous to kill the blight is injurious to the tree, and furthermore it is difficult to make a tree absorb any very great amount of material injected into it.

Cutting Infected Trees. The removing of all infected trees has been tried but as with the other remedies its success has been only indifferent at the best, as it is hard to find all infected trees when scouting for the disease, and the few not found are sources of new infections. The expense and trouble of destroying infected portions of the tree after cutting makes this method of control out of the question for treating chestnut woodland.

Thus at present we are without any effective method of combating this trouble in the forest and at best are only partly successful with single specimens in a yard or park.

DISSEMINATION OF SPORES.

There are several ways in which the blight may be spread, but from our own observations it would seem that the wind and possibly birds, especially those which hunt for larvæ of insects in the bark, are chiefly responsible. It can be readily seen that when an affected tree is producing countless millions of such minute spores the wind will easily blow them to a considerable distance. This is especially true of the winter spores, which are forcibly ejected from the sacs in which they are borne. These spores lodging in a wound in the bark of a chestnut tree or being washed there by the rain would start a new infection of the disease. As the summer spores are produced in sticky masses, birds may pick them up on their beaks and feet and thus carry them to new localities. Other ways of dissemination are insects and transportation of diseased chestnut wood from one place to another. The fungus often produces spores for one or two years on cut wood especially when the bark has been left, so that diseased wood can be a source of infection for

some little time. Rains are very effective in washing spores to various parts of the tree below the infected portion.

PROGRESS OF DISEASE.

While we have not much definite data at hand to show just how fast the disease progresses after attacking a large tree, we have found by inoculating small seedlings and sprouts that these may be entirely girdled in one season, and from general observations on marked trees at Stamford and Middlebury it takes at least two years to kill the tree and probably three or four. Of course how long it takes the blight to kill a tree

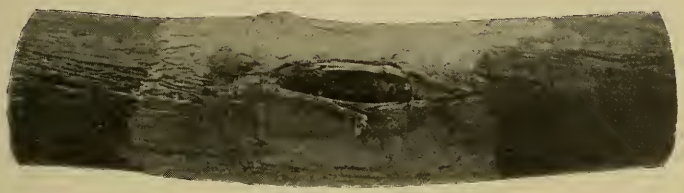

FIG. III. SPROUT WITH DEAD BARK AROUND INOCULATION POINT.

depends on where the tree is attacked. If it is attacked on the small branches these will be killed but the rest of the tree will remain healthy and in a growing condition for a considerable time. On the other hand if the infection is on the main trunk this will be girdled and the entire tree killed in a much shorter time. Certain weather conditions also apparently affect the rate of development of the fungus.

DISTRIBUTION IN CONNECTICUT.

At the present time the chestnut blight is distributed entirely over Connecticut. The accompanying maps show its spread from 1908 to 1912 and also show approximately the varying degrees of damage done in various parts of the state. The trouble is more serious in the southwestern part of the state and west of the Connecticut River. This is probably due to the fact that there is more chestnut in the western half. It was reported

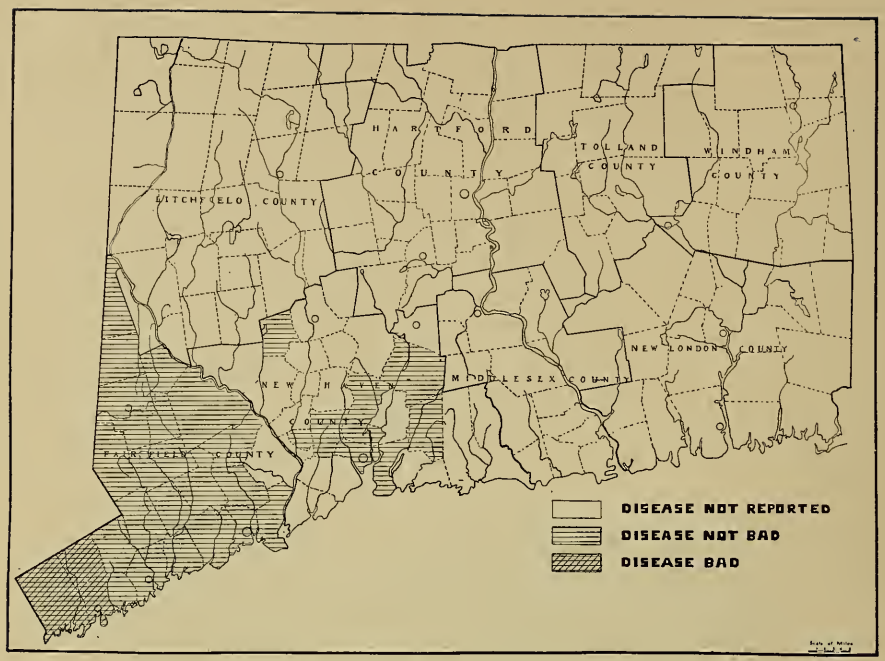

FIG. IV. KNOWN DISTRIBUTION OF CHESTNUT BLIGHT IN 1908.

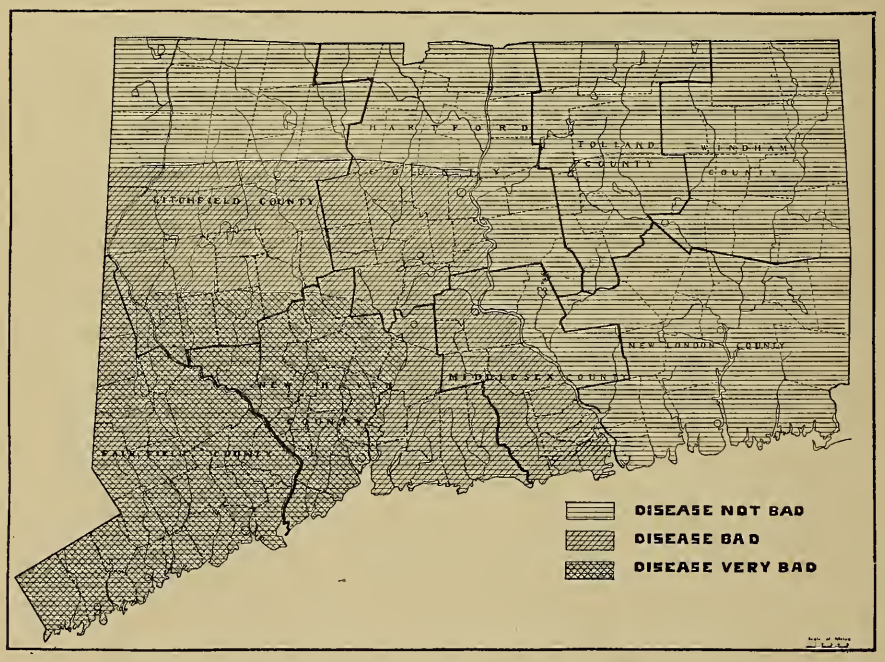

FIG. V. KNOWN DISTRIBUTION OF CHESTNUT BLIGHT IN 1912.

DISTRIBUTION OF CHESTNUT BLIGHT IN CONNECTICUT.

first in the southwestern towns of the state but recent studies of the disease prove that it was present to a greater or less degree in scattered localities throughout the state as early as in these reported towns.

DISTRIBUTION IN THE UNITED STATES.

Chestnut blight is present in Massachusetts along and west of the Connecticut River, in Rhode Island it is scattered and seri-

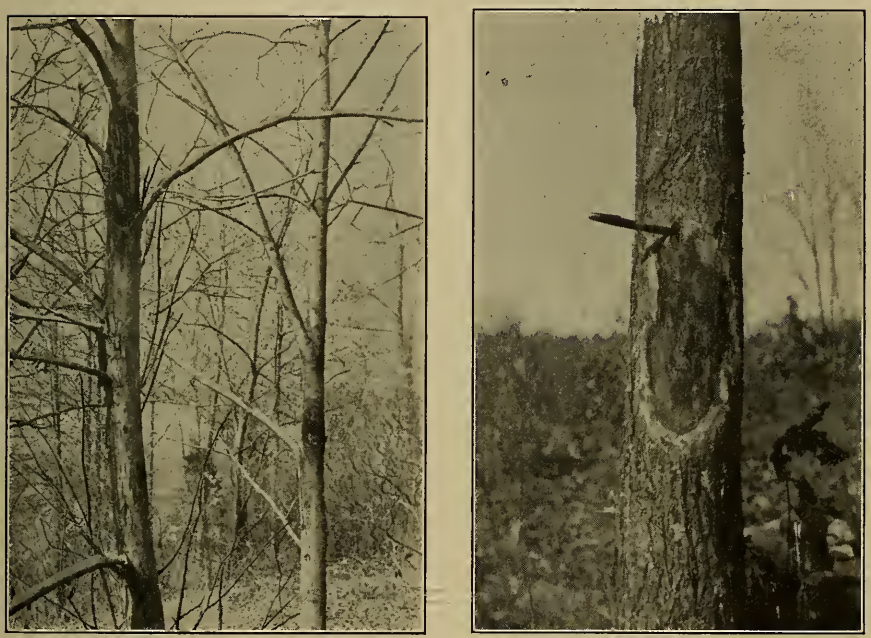

FIG. VI. A–B. CANKERS ON SMOOTH (A) AND ROUGH (B) BARKED TREES.

ous in certain localities, and it has also been reported from Vermont and New Hampshire. In New York it is progressing north along the Hudson River and is present in western Long Island. In New Jersey the chestnut has suffered over the entire state and in Pennsylvania the trouble is serious in the eastern and bad in the southeastern part. The disease occurs generally in Delaware, while Maryland, Virginia and West Virginia have it scatteringly, the points of infection being few and inconspicuous in the latter state. Thus we see that the disease is

spread in varying degrees of seriousness over nearly the entire northern territory where chestnut grows.

RELATION TO HOST CONDITIONS.

From our own observation and from the opinions of woodland owners who have watched the spread of the disease it would seem that the dry seasons, which are unfavorable for the growth of the chestnut, have been an important factor in the spread of the disease. It has been found that chestnut growing on dry hill-tops is generally more seriously affected with the blight than that in lower land where there is more moisture. Chestnut growing on dry hillsides has been evidently killed entirely by dry conditions, as no blight could be found on it. Chestnut injured by fire or in other ways is invariably more quickly attacked by this disease and often it is the trunks of these trees which are infected, thus causing the death of the tree much quicker than if the twigs and small branches were attacked.

Instead of the chestnut bark disease being an introduced disease as is thought by some, it seems more probable that it was present in this country, growing inconspicuously on dead and dying trees, and that after the chestnut was weakened by a succession of dry seasons it became an active parasite and attacked and killed living trees.

PRESENT SITUATION AND FUTURE PROSPECTS IN CONNECTICUT.

The present situation in Connecticut is that the disease is still spreading and unless its progress is checked by some natural causes the future prospects are not bright for chestnut in this state. However, instances have been noted where trees were overcoming the disease and blight cankers which had attained a diameter of eighteen inches were healing over, this healing process having been begun in 1911. This condition is not general, but if it is possible for some trees which have had favorable growing conditions to overcome the disease we may expect that if the seasons are such that the trees are able to make a more vigorous growth the disease will decrease in virulence considerably. Of course, predictions as to the final outcome are at best rather uncertain and evidence at hand furnishes arguments for

both the optimist and the pessimist, but until the chestnut is nearer extinction than at present, a prediction of ultimate destruction does not seem warranted.

WORK DONE IN CONNECTICUT.

The work done on the chestnut blight in Connecticut by the Experiment Station consists of a survey of the state to determine the extent and seriousness of the disease, and of a thorough inspection of a tract on the state forest in Portland for the purpose of locating and cutting out diseased trees and also a plot where affected trees were located, counted but not cut out. Besides this a large amount of laboratory work has been done to determine various points of scientific interest in regard to the life history and cultural characteristics of the blight fungus.

The survey of the state was made by members of the Botanical and Forestry Departments visiting and locating the disease in all towns from which specimens had not already been received. In this survey no attempt was made to locate definitely all the points of infection in every town, but each town was inspected in a very general way to locate the disease and get an approximate idea of the amount of chestnut.

The work in the Portland forest consists of a thorough inspection of a definite tract in which all infected trees are located, cut out, the brush burned and the infected timber removed and peeled. Such as is not large enough for timber is burned for charcoal nearby. As a check on the results obtained on this tract an adjacent tract is inspected, the trees counted and not cut out, thus showing whether the cutting out has any control on the disease. This has been done for two years and, while the results have so far been negative, this experiment must be carried on for a series of years to arrive at definite conclusions. Besides this inspection a small amount of work has been done in the way of peeling or burning the infected stumps to determine the effect of such treatment on the sprouting of the stumps and on the destruction of the disease. At this writing it is too early to say what the results of this experiment will be. Judging from the time taken to do a small amount of such work it would prove too expensive for the owner of timber land to undertake cutting diseased trees and burning the stumps.

WORK DONE BY OTHER STATES.

The work of studying and combating chestnut blight has been taken up by the various states in various ways and on a larger or smaller scale according to the views of the investigators and

FIG. VII. SMALL BRANCHES ON OPEN GROWN TREE KILLED BY BLIGHT.

to the amounts of money appropriated for the work. Massachusetts has done some work in locating the diseased areas, but nothing in the way of control measures, the same course being followed by Rhode Island. Pennsylvania has expended $275,000 on the study and work of combating the blight. Spraying, cutting out infected trees, medication and tree surgery were tried,

and while many experiments of interest have been performed no very definite progress, in our opinion, has been made in discovering successful and practical measures of control.

Maryland, Virginia and West Virginia are expending small sums on locating points of infection with an idea of possibly removing the scattered areas of infection at a later date if the success of such treatment shall seem to warrant it. The chestnut in New Jersey and Delaware has been so nearly destroyed that little work of any kind has been undertaken.

HISTORICAL CONSIDERATION.

The chestnut blight was first noticed in the New York Zoological Park by H. W. Merkel in the summer of 1904. In 1905 it was so serious that measures were taken to control it, and the first description of the trouble was published in the report of the New York Zoological Society for that year. From a botanical standpoint the first work was done by W. A. Murrill of the New York Botanical Garden in 1906. Shortly after Murrill's work the study of the blight was taken up by Clinton of this Station and by Metcalf and Collins of the United States Department of Agriculture. Since then many investigators have become interested in the study of this disease and the opinions and discoveries have been nearly as numerous as the investigators.

RANGE AND CONDITIONS OF GROWTH.

Chestnut ranges from southern New Hampshire south to Georgia and Alabama. Connecticut is near the northern limit of its range, which accounts for the decrease in per cent. of this species toward the northern part of the state and on the cool northern slopes.

It occurs nearly pure on medium to deep well-drained sites, but on the drier ridges and in the swamps it is crowded out of the stand by species better adapted to the conditions. This tree requires direct light and forms a wide spreading tree in the open, while in the forest the demand for light causes increased height growth, forming a clear full-boled tree. Chestnut sprouts very abundantly, even when the tree cut is 100 years or more in age. The nuts are largely eaten, but a few are scattered by the birds and animals which accounts for the numerous seedling trees to be seen in abandoned fields. The

sprout tree grows much more rapidly in youth but the seed tree will often overtake and pass it in forty-five or fifty years.

Chestnut forms the larger part of the stand in the southern counties of the state but decreases in the northern portion, where white pine is more abundant. East of the Connecticut River it does not form as large a percentage of the stand as in the

FIG. VIII. PURE STAND OF CHESTNUT.

western part of the state. It usually occurs in pure stands or mixed with oak, tulip, and other hardwoods.

CHARACTER OF WOOD AND UTILIZATION.

Its wood is durable in contact with the soil and has been largely used in the form of posts, ties, and other products which are exposed to the weather. The stands in the northern portion of the state have been coaled a number of times to furnish charcoal for the iron mines which have been in operation there since colonial days. The wood is soft and easy to cut, and when dry burns with a steady heat leaving little ash, which fact has resulted in the use of this species to the almost total exclusion

of the hard woods in the brass industry. The brickyards and the lime kilns also use it when it can be obtained. These numerous uses for the smaller products, such as cordwood, have resulted in large areas of sprout forests under 30 years of age, in which the percentage of chestnut has been on the increase, due to the great vigor with which the stumps sprout. In those sections of the state where the market for cordwood is not as good, the stands are usually left until pole or tie size. Here the percentage of seedling trees is slightly greater, due to the increased seed production of the more mature trees. These stands, as a whole, are mixed with a greater variety of species and are in a better condition to withstand the spread of the chestnut blight, as there are in many cases enough trees of other species to continue the stand even if the chestnut is entirely removed. There are very few stands in the state in which the trees are of a size to make lumber. This is largely due to the ready market for ties and poles, but it is also due to the fact that in a sprout stand the trees begin to deteriorate after it reaches the age of fifty to sixty years.

Native chestnut is the wood most used in this section for ties and poles. Chestnut and red cedar are most commonly used for posts. Chestnut is used for timbers in the construction of a large number of buildings, especially on the farm where the owner has his own wood lot. When the tree is large enough to saw, the planks are commonly used in the wooden bridges to be found throughout the state. The boards are used as rough siding and to a limited extent in the manufacture of boxes, but this use is limited by the weight of the lumber. As an interior finish, this wood is coming into favor, but up to the present time the southern lumber is preferred because of better milling and closer grading. Chestnut is used in furniture as the core for veneering.

MILL PRACTICE.

The chestnut of this state is milled by small portable outfits which have a daily capacity of five to fifteen thousand feet per day. The timber holdings are small and a mill has to make frequent moves which tends to make the owner careless in setting up, with the result that there is a tendency to produce lumber of varying thickness. The mills have circular, inserted

tooth saws which cut out a 9-32 inch kerf, which means a loss of one board in four. This is probably unavoidable as the stands of timber are so small that any other form of mill is out of the question, but the unnecessary loss due to the saw not lining up or the teeth not being in good shape is avoidable. Where the stand is being cut for ties the felling crews cut the logs into tie lengths, and the sawyer does not save the boards that the cut may contain above the tie contents, as there is little demand for eight-foot boards. If the logs were cut in two tie lengths, this question of the short board would be avoided and a merchantable product obtained in place of a thick slab.

The sale of a stand by the thousand feet is undesirable since there is then a tendency on the part of the operator to cut as rapidly as possible, and not to get the maximum amount out of each log. There is a lack of appreciation of the loss from the cutting of high stumps and leaving merchantable material in the tops. If the stump is six inches too high, the loss in the average tree is from one to two per cent. and it is the best timber in the tree which is wasted.

RECOMMENDATIONS.

Cutting a stand of chestnut simply because there are a few diseased trees scattered through it is to be avoided if possible. The stand should be watched and when the loss from the disease is greater than the increase by growth the stand should be cut. The value of the timber is steadily increasing so long as it is growing thriftily, and it is good policy to hold a stand as long as possible, to get the greatest possible growth and this increase in value. A tree killed by the blight is still merchantable, as the timber is not affected so far as can be determined by test.

The owner of a timber lot should cut out the diseased trees, not so much to prevent the spread of the infection as to save the material already grown. In cutting a stand it is advisable to leave species other than chestnut so that there may be some reproduction by seed to take the place of the chestnut if it does not recover sufficiently to sprout.

In a pure chestnut stand where the infection is bad, clearing of brush and planting with pine is the best method for keeping the area in forest.

SUMMARY.

1. The chestnut blight is caused by the parasitic fungus Endothia gyrosa var. parasitica and not by an insect.

2. The chestnut bark disease is slowly and surely killing the chestnut in Connecticut, and will continue to do so unless stopped by natural causes or some effective remedy can be found.

3. All methods of control that have been tried have proven only partially successful and are not practical for use in woodland.

4. It is believed that dry weather conditions have weakened the tree and enabled a native fungus to become an active parasite and that the disease has not been introduced from a foreign country.

5. If individual infected trees are cut and the bark and brush burned on the stumps, the spread of the disease may be checked, but experiments show that in most cases the surrounding trees are already infected, and the disease is only temporarily checked.

6. The presence of the disease in the stand in itself is not sufficient reason for cutting. Unless the trees are mature and the market condition is good, it is better to give the uninfected trees a chance to get all the growth possible, especially where the presence of the blight has only just become apparent.

For a more detailed report on this subject the reader is referred to the Report of the Botanist, Connecticut Agricultural Experiment Station, 1911-1912.

University of
Connecticut
Libraries

39153029221266